International Journal of Botany and Research (IJBR)
ISSN(P): 2277-4815; ISSN (E): 2319-4456
Vol. 7, Issue 2, Apr 2017, 25- 34

BREEDING OF MEDICINAL AND AROMATIC PLANTS-AN OVERVIEW

LAKSHMAN CHANDRA DE

ICAR-NRC for Orchids, Pakyong, Sikkim, India

ABSTRACT

The rise of chemical taxa of Medicinal and Aromatic Plants (MAP's can be considered as result of biochemical and metabolic processes mostly under genetic control. The phenotypes of plants are influenced not only by environmental but also by genetic factors, which are inherited from parents by their progenies. The breeder creates the genetic variability and tries to change the genetically controlled reaction norm of a genotype towards the aspired direction – the improvement of the average performance and of the ecological stability. Conventional breeding methods prevail due to the availability of high natural variability. New variability can be created by following different breeding methods such as combination breeding, hybrid breeding, synthetic cross, induced mutations, somaclonal variations, molecular gene transfer, clone breeding, selection and chemo variations.

KEYWORDS: MAP's, Environmental, Mutations, Somaclonal Variations

Received: Feb 02, 2017; **Accepted**: Mar 21, 2017; **Published**: Mar 25, 2017; **Paper Id**.: IJBRAPR20175

Original Article

INTRODUCTION

The basis for use of medicinal plants is that these plants contain so called active principles that affect physiological processes of living organisms. Aromatic plants indicates plants having sweet smelling or fragrant aroma. In modern ages, Medicinal and Aromatic Plants (MAP's) are defined as fragrant ingredient containing group of medicinal plants. The basic taxonomical unit of MAP's is known as *species* (sp.) with related species constituting a *genus.* The categories *subspecies* (subsp.), *variety* (var.) and *form* (f.) are used to differentiate among random populations of wild growing species. In fact, both natural and cultivated species are divided into *infra-specific* varieties.

A number of chemical, cytological, morphological and ecological properties are used for correct description of MAP's. In such cases, the species represents either homogenous taxon of plants with little variation from one specimen to another or it may contain varieties or races with distinctive features. Sometimes, these varieties represent single gene mutations and are morphologically recognizable. Otherwise, the mutation gives rise to a variant with secondary metabolic profile. These are called *as chemical races* or *chemodemes*. In addition, there are other genetic variations that affect the chemical constituents of the species, e.g., the appearance of polyploids, extra-chromosomal types, gross structural changes to the chromosomes and genetically produced modified plants.

Secondary metabolites usually derived from the precursors produced by the primary metabolic processes are found only in one plant species or related group of species. These metabolites protect plants against plants being eaten by herbivores or being infected by microbial pathogens. They serve as attractants for pollinators and as agents of plant-plant competition and plant microbe symbioses.

The rise of chemical taxa of MAP's can be considered as result of biochemical and metabolic processes mostly under genetic control. It is assumed that differentiation of cell is mostly manifested in chemo-differentiation at a molecular level and the fundamental differences of protein present in the organism, i.e. in differences between enzyme systems. The special chemical features of MAP's are attributed to dissimilarities in the metabolism. Besides, infra-specific chemical modifications can be caused by ecological and geographical conditions. These chemical differences can be called as polychemism. Polychemism is known to occur frequently in autogamous species.

The phenotypes of plants are influenced not only by environmental but also by genetic factors, which are inherited from parents by their progenies. The breeder creates the genetic variability and tries to change the genetically controlled reaction norm of a genotype towards the aspired direction – the improvement of the average performance and of the ecological stability. Breeding is one of the most important key factors for improvement of the MAP branch because the genotypes are adapted to the special demands of the players in the production chain and contribute to high quality, profitable and sustainable production. The exploitation of the genetic potential of MAP is still in its fancy stage. Conventional breeding methods prevail due to the availability of high natural variability. Nevertheless, the use of biotechnological tools and research on genes controlling the secondary metabolite formation and their transmission are in experimental stage. Success has been achieved in the development of expense saving selection methods.

Common Breeding Objectives

Some general breeding objectives for MAPs are:

- High and consistency for stable yield,
- Resistance to insect pests and diseases, as well as to abiotic stresses)
- High functional value and safety
- Suitability for technological applications in agriculture e.g, rapid youth development to suppress weeds, harvest machines require simultaneous maturity, upright growth, resistance to lodging, limited range of the flower horizon, no shattering tendency of the seeds or fruits, closed capsules
- Provision of low input (low nutritional requirements), cost saving and sustainable production
- Effective protection of plant breeders' rights (e.g, by hybrid varieties)

Breeding Objectives Relevant to Postharvest Processing

Homogeneity

Homogeneity of the plant material which makes easy for all mechanised and postharvest procedures, and provides the prerequisites for the production of uniform qualities.

Constituents

The value of herbal drugs is estimated by the biologically active constituents, while the extraction yield depends on their concentration in the crude drug.

Therefore, MAP breeding mainly emphasises on essential constituents: There should

be:

- High content of desirable compounds to economise extraction and allow microbiological decontamination procedures,
- Absence of harmful substances to avoid expenses for eliminating them after harvest
- High dry matter content to save the energy consumption for drying
- High antimicrobial properties of the constituents to inhibit decay of the herbal material

Morphology

The morphology of the plant effect the feasibility of mechanised harvest and therefore the suitability of the harvested crops for postharvest processing. Morphological considerations include:

- Thick roots with low ramification to ease root washing after harvest and industrial processing
- Upright growth genotype to facilitate mechanised harvest of herbal drugs (eg, *Origanummajorana*, *Thymus vulgaris*, *Digitalis lanata* and *Plantagolanceolata*)
- Short flower horizon (eg, of *Chamomillarecutita*and *Hypericumperforatum*) stands to enrich the flower portion in the harvested cropsresistance of *Chamomillarecutita*flower heads to disaggregation after drying
- Small grained *Foeniculumvulgare*fruits for good functioning of machines
- Resistance to disintegration of both achenes of *Coriandrumsativum*fruits
- Major of leaves and minor portion of stems in the herb (eg, *Mentha*x*piperita*, *Melisseofficinalis* and *Origanummajorana*) to improve the yield of leaves after mechanical separation
- High ratio of ray florets in case of *Calendula officinalis*
- Low share of stems adhering to the fruits of *Carumcarvi*to facilitate cleaning procedures
- Resistance to grain shattering during the maturity period (eg, of *Foeniculumvulgare* and *Carumcarvi*)
- Oil glands (eg, of *Mentha*x *piperita*, *Origanummajorana* and *Salvia officinalis*) should be resistant to damage from mechanical stress due to crushing and milling.

Demands on MAP Cultivars

Breeding results in improved cultivars which are indispensable for the production of high quality products in a sustainable and profitable way. But, the breeding objectives differ depending on the position of the players in the production chain. The players are seed companies, farmers, trade and industry, consumers and also the general public. Some typical breeding objectives are: high and stable yield, homogeneous raw material, high content of desired active quality compounds and absence of harmful substances, resistance to biotic stress (insect-pests and diseases), resistance to abiotic stress (environmental factors) and high functional value and safety. MAP cultivars must be fit for the technological processes in agriculture and industry, for low input, cost saving and sustainable production and also for an effective protection of plant breeders' rights. A list of cultivar of medicinal and aromatic plants are given in Table 1.

Specifics of MAP Breeding

Breeders of MAP cultivars confront with some special features. In case of agricultural crops, only a few results of breeding research are available - e.g. on the genetics of certain traits and on breeding methods, that MAP comprise a particularly great number of species, that often the breeding objectives differ on one and the same species depending on the field of usage, that the analyses of the important constituents are particularly costly, that only limited capacities for breeding research and breeding are available for these minor crops, and that refinancing of the breeders' expenses is insufficient due to the small saleable seed amount. But, the breeder can exploit high natural variability because breeding of MAP is in its initial stage only so that a high progress is achievable already after a few selection steps. In view of these specifics and to ensure an adequate cost-value ratio, breeders have to plan very carefully which crops, breeding objectives and breeding methods are to be chosen.

Utilization of Natural Diversity

Sources of natural variability are accessions collected in the wild, accessions from germplasm

collections - e.g. from gene banks and botanical gardens -, furthermore old primitive cultivars and landraces, and contemporary used cultivars for last two decades. Introduction of a high performance population selected among a great collection of different accessions can already provide an enormous progress in adaptation of a MAP species to the demands, even without additional time-consuming and expensive breeding procedures.

Creation of New Variability

New variability should be created if the initial material does not provide the desired trait expression. Some common methods are described as follows:

Combination Breeding by Crossing

The aim of crossing is the combination of trait expressions of the parents (donors of certain characteristics) in common progenies. The pollen of the male parent is transferred on the stigma of an emasculated flower of the femaleparent, and the pollinated flower must be kept isolated, e.g. with a paper bag, during the period of stigma fertility. Elite plants with the desired trait combination are selected in the following segregating generations and bred to constancy. This method is most common in MAP breeding to create new variability (Pank, 2002). Recurrent back crossing is used if a valuable trait, e.g, of a wild accession, will be transferred to an established variety. The variety is repeatedly fertilised with the pollen of the donor accession and only plants combining the good characteristics of the variety and the valuable trait of the wild accession are selected in the progeny. This procedure is completed when the desired trait expression of the wild accession is thoroughly transferred to the variety.

Hybrid Breeding

Hybrid breeding is very popular in important agricultural and horticultural crops but in MAPs it is still in the beginning stages. Hybrid varieties excel by high performance due to hybrid vigour and uniformity, and by the natural protection of plant breeders' rights because unlicensed seed propagation results in worthless segregating populations. Seeds from hybrid varieties are produced as F1-generation of selected parents with good combining ability. Good combining ability means that the performance of the F1-progeny of these special parents is particularly high. F1 seed production of certain parents needs controlled pollination. For hybrid breeding or out breeding MAP, preferably lines with

genic-cytoplasmatic pollen sterility should be used for this purpose to minimise the expense for emasculation. Hybrid varieties need the development of separate lines with the following characteristics; 1) male sterile; 2) male fertile with maintainer properties to maintain the male sterile line; 3) male fertile pollinator with good combining ability for F1 seed production; and 4) if generative organs are harvested and the pollinator parent has no restorer properties, a male fertile restorer has to be added to the F1-seeds to ensure a sufficient seed set in the production field. Advances in the development of hybrid cultivar systems are reported (Rey, 1994; Langbehn et.al, 2001)).

Synthetic Cultivars

Synthetic varieties based on several – more than two as known for hybrid varieties – well combining parental populations. The seeds are also produced from advanced generations (Lenzi et al, 2003). Their potential performance can also reach the level of hybrid varieties, but the uniformity will be lower in general. The combining ability of parental populations (inbred lines or clones) is assessed by combining ability tests. Lines with the best general combining ability are selected as parental components of the synthetic variety and are maintained by the breeder. For seed production, the selected components are cultivated together. The seeds of this panmicticly reproduced mixture are sold as seeds for production only in the second or third generation because the heterozygosis as basis for high performance can largely survive in the following generations.

Induced Mutation

The spontaneous mutation rate of plants can be increased by the use of e.g, radiation or mutagenic chemicals (Punia and Ramkrishna, 2002). The change of the genome by a mutation inducing agent results in a different reaction norm of the mutated plants compared with non- mutated original plants. A disadvantage of this method is that the emerging mutations and the changes of the related trait expressions occur by chance and may be erratic. Induced mutation results in new variability of the mutants themselves or in segregation of the progeny of mutants crossed with existing genotypes. Examples of successful breeding by mutation induction are the high yielding peppermint-variety 'Multimentha', which has a high essential oil content and resistance against *Pucciniamenthae.* Further examples of successful mutation breeding are *Chamomillarecutita* ('Zloty lan', 'Bodegold'), *Origanummajorana* ('Miraz', 'Tetrata'), *Verbascumphlomoides* ('Polyverb') and *Lavandulavera* (Slavova et al, 2004).

Somaclonal Variation

Also the *in vitro* culture stress in cell and tissue cultures coupled with processes of de- and redifferentiation acts mutagenically. Selection is accomplished on the cell level *in vitro* or on the level of fully functional plants regenerated from tissues or cells. Several authors have studied somaclonal variation on *Datura*sp. And *Viscum album*.

Somatic Hybridisation (Protoplast Fusion)

Protoplast fusion is indicated if there exist natural barriers (incompatibility) to cross different donors of desired trait expressions. In this method, the protoplasts of different genotypes are fused without any meiotic recombination, the two heterozygous genomes are combined and the fused protoplasts are regenerated to functional plants. Protoplasts of e.g, *Catharanthusroseus/Vinca minor*, *Rauwolfiaserpentina/ Vinca minor* and *Rauwolfiaserpentina/Catharantusroseus* were successfully fused.

Molecular Gene Transfer

Molecular gene transfer shortens the breeding procedures at considerable rate. A lot of on-going research also with MAP is concerned with the clarification of the biosynthetic pathway of important secondary metabolites, the identification of related enzymes, the isolation of encoding genes, and the establishment of protocols for the gene transfer. These investigations are very expensive and till date successful breeding of transgenic cultivars with economic importance is scarcely known.

Clone Breeding

Clone breeding means the vegetative propagation of selected high performance individual plants. Vegetative propagation involves identical reproduction of the clone variety –particularly important in the case of allogamous species – without the time consuming procedures for breeding to consistency. Sterile plants, e.g, *Menthaxpiperita*, can be propagated only vegetatively. Clone breeding remunerates only for high priced MAPs like *Baptisiatinctoria* (L.) R. Br due to the high costs of vegetative propagation – mostly carried out by micro propagation *in vitro* – in comparison to generative reproduction (Kadner et al, 2002). The generation of artificial seeds is an other method of vegetative propagation as mentioned with *Cymbopogon martini* and *Echinacea angustifolia.*

Selection

If a population with an appropriate natural or artificially generated variability is available, the breeders initiate the improvement of the population by selection. Selection accumulates the genes in a population which control the desired trait expressions. It retains fitness while inbreeding increases uniformity. Selection in wild populations or landraces is the most common way in medicinal plant breeding, because most of the species are yet in the stage of wild plants with high genetic variability. Only a few selection steps provide already satisfying results.

Selection Methods

Common selection methods in MAP breeding are mass selection, recurrent selection, pedigree breeding (selection of elite plants and testing their progenies), selection breeding in apomicts, and clonal breeding (Allard, 1999). Clonal breeding has a particularly high importance for MAP because this method shortens the breeding procedures considerably. Due to the high costs of vegetative propagation mostly done by micropropagation *in vitro*, clonal breeding is appropriate only for high priced MAP.

Improvement of Selection Efficiency

The objective of selection is to achieve a high selection response with only low expense in time and money. Breeding a new cultivar with classical methods requires 10 to 15 years from first crossing up to cultivar registration. Therefore, all possibilities are to be used to reduce this period by improving the selection response. The formula i*h2*σ shows the factors affecting the selection response (R). The amount of individual plants in the initial populations should be as high as possible to improve the selection intensity (i). The heritability (h2) can be improved by an appropriate precision of the measurements of characteristics. The populations must show a high variability (σ).

Knowledge of the differing reproduction biology of the species can be used to arrange the breeding procedures most effectively which are divergent, e.g., for inbreeding species and for out breeders. The succession of generations can be accelerated e.g. by cultivation of an additional generation during winter in the glasshouse or by flower induction by

vernalization or special illumination, e.g., of an *Achillea*species. Early selection on the level of young plants, calli or cell suspensions saves expenses because the cultivation period of low performance individuals is reduced. Effective methods for the test of resistance against insect-pests and diseases are an indispensable prerequisite for resistance breeding. The use of doubled haploids generated from microspores speeds up the time consuming process of breeding on homogeneity. Traits whose expression are measured only with high expense can be evaluated more easily by means of a strongly correlated marker: such markers are e.g. morphological and physiological, chemical and molecular.

Acceleration of Generation Sequence, Vernalization and Photoperiodic Reaction

Further tools for reducing the breeding procedure are: to accelerate the sequence of generations by eg, additional generations during winter in the greenhouse with *Carumcarvi;* flower induction by vernalisation of *Salvia officinalis* with *Thymus vulgaris*, regarding the typical photoperiodic reaction of a species. Early selection saves expenses by selecting and removing low performance individuals in an early developmental stage.

Doubled Haploids

The time consuming breeding for homozygosis can be saved by generating doubled haploids of *Allium cepa* and several other MAPs.

Selection in Apomicts

Selection in apomictic plants with asexual seed formation without fusion of two reduced gametes is particularly effective because the progeny has the same genetic constitution as the mother plant, and it is already true breeding without further selection steps. Apomixis is also be found in some MAPs, for example in *Coriandrumsativum* and *Ocimumbasilicum*. Recent experiences were also gained with the apomictic *Hypericumperforatum*.

Rapid Analytical Methods

One of the most important breeding objectives is the improvement of the content of essential constituents. But, the huge expenses for chemical analysis are a limiting factor. Therefore, the development of special analytical methods for MAP breeding is an indispensable prerequisite to provide a sufficient selection intensity by analysing an appropriate amount of individual plants. Analytical methods must fulfill the following demands: time and cost saving to allow the evaluation of as many individual plants as possible, non-destructive for keeping the investigated plant material alive for following breeding procedures, small sample quantities because single plants or parts of them are to be evaluated, direct analysis without preceding sample preparation is preferred, the precision must be reliable. A lot of expenses can be saved considering the fact that the accuracy must not comply with the high level of standard methods. For example, the rapid and non-destructive near infrared spectroscopy and the solid phase micro-extraction proved well in MAP breeding.

Chemo-Variation

Differences of flower colours and aroma as well as fruit flavour from similar looking plants have been known from the everyday experience of mankind since ancient ages. Infra-specific chemical diversities (IsCh) are found based on chemical, biochemical and biosynthetic results since the beginning of the 20th century. Worldwide results had shown evidence that direct procedures of clearing genetic similarities on chemistry of plants were efficient methods. The new research trend gives a new opportunity for disclosing real DNA and biosynthetic causes of chemo-differentiation, opening great perspectives for the breeding of new, high-powered chemo-cultivars of medicinal and aromatic taxa.

Molecular Markers in the Improvement of the Medicinal Plants

With the advancement of DNA based different molecular markers and molecular breeding approaches open upmany new strategies to plant breeders and geneticists to resolve many of decades old problems faced during conventional breeding of medicinal plants. Molecular markers are unique in nature and related directly to the plant's genotype. Genetic diversity among individuals or populations can be calculated using morphological, biochemical and DNA based molecular markers. Till date, only few reports of molecular marker-based approaches to medicinal plant improvement, and not even the most skeletal of genetic maps is available for any of the important industrially important species except for *Artemisia annua*. This study not only had shown the importance of molecular basis for marker-assisted breeding of *A. annua* but also highlights the significant shortening in time that are now feasible for developing this platform of knowledge and tools. Selection assisted by genetic markers is an annexe of traditional crop breeding, which has been exploited in food crop improvement. Again, it is a means to recognize desirable genotypes at an early stage to speed up the selection process. Identifying a novel functional gene and useful marker sequences linked to them in a plant species is a time consuming and costly technical affair. Plant genome sequencing has developed rapidly since the first genome (*Arabidopsis thaliana*) was completed in 2000 followed by the 389-Mb rice genome was completed in 2004. There is a high degree of match in the DNA sequences of functional genes between different plant species; therefore, DNA probes from one species can often be used to identify homologous sequences in another closely related species. The key developmental challenges for molecular markers now depends on developing new breeding strategies where the objectives will be increasing the germplasm base and increasing the number of traits that can be effectively selected simultaneously. The new marker technologies that offer greatly reduced costs in marker screening and high multiplexing capabilities will be accent to these developments. Essentially the whole genome-based selection strategies are followed where specific recombinational events are sought and changes will be assessed on a genome-wide scale. In this way, one can go for better management of chromosome regions that may come from wild relatives or land races, track several traits at once and keep the population size as small as possible. It is believed that despite the relatively small adoption of markers in different medicinal plant breeding to date, there is a greater level of adoption in the next decade and beyond.

Factors that should enforce to a greater adoption of MAS in medicinal plants include:

- Establishment of facilities for marker genotyping and staff training within many medicinal plant breeding organizations in different corners of the world.
- Currently available data on genes/QTLs controlling traits and the identification of tightly-linked markers in different plants
- Development of useful strategies for using markers in breeding
- Establishment and creation of public databases for QTL/marker data especially for various medicinal plants
- Available resource for generating new markers from DNA sequence data from different medicinal plant genome sequencing and research in functional genomics.

It is also important that future endeavors in marker assisted selection are based upon lessons that have been learnt from past successes and failures in using MAS. Further optimization of marker genotyping methods in terms of cost-effectiveness and a higher level of integration between molecular and conventional breeding represent the main challenges for the greater adoption and impact of MAS on different medicinal plants in the near future. The choice of the

most appropriate marker system, however, requires to be decided on a case-by-case basis and will depend on many issues including the availability of technology platforms, costs for marker development, species transferability, information content and ease of documentation.

Table 1: Improved Varieties of Medicinal and Aromatic Plants

Common Name	Botanical Name	Improved Varieties
Isabgol	*Plantagoovata*	Gujarat Isabgol-I, Gujarat Isabgol-2, Haryana Isabgol-5, Jawahar Isabgol-4, Niharika
Opium poppy	*Papavarsomniferum*	Jawahar Aphium-16 (JA-16), Jawahar Opium 539, Jawahar Opium 540, Trishna(I.C. 402), Shaktiman, Kirtiman, Chetak=Aphium, Sujata, TOP-1, NBRI-1, NBRI-6, NBRI-9, NBRI-10, Mandakini, Raksit, Sanchita, Vivek, Sweta, Subhra, Shyama
Senna	*Cassia angustifolia*	Anand Late Selection, Sona, TinnevellySenna, KKM-1
Periwinkle	*Catharanthusroseus*	E.C. 120837 (Russia), I.C. 49581, Nirmal
Liquorice	*Glycyrrhizaglabra*	E.C. 114304 (Russia), E.C. 41911 E.C. 128587 (Pakistan), Haryana Mulhatti-1
Ashwagandha	*Withaniasomnifera*	R.S.1. Jawahar Asgand-20, NMITLI-118, Jawahar Asgand-134,Rakshita, Posita, Manasa Local, Kukedesher
Jasmine	*Jasminumgrandiflorum*	Pitchi, ArkaSurabhi
Palmarosa	*Cymbopogon martini* var. *motia*	I.W. 31245, “CIMAP HARSH’, Rosha Grass-49, CI-80-68, Vaishnavi, Trishna, Tripta ;PRC-1
Vetiver/ khus	*Vetiveriazizanioides*	KS-1, Sugandha, Pusa Hybrid-7, Hybrid-8, CIMAPKS- 2, Sugandha, KH-8, KH-40, ODV-3, Keshari, Gulabi, Dharini, Hybrid 8
East Indian Lemon grass	*Cymbopogonflexuosus*	Sugandhi Pragati, Nima, Cauvery, Krishna, NLG-84, O.D. 410
Lemon grass	*Cymbopogonpendulus*	Praman Hybrid of *C. khasianus* × *C. pendulus*CKP-25
Chamomile	*Matricariachamomilla*	CIMAP “SAMMOHAK”
Lemon grass	*Cymbopogonkhasianus*	“CIMAP SUWARNA”
Mint	*Menthaarvensis*	“CIMAP SARYU”, Hybrid 77
Mint	*Menthapiperita*	Siwalik
Mint	*Menthaspicata*	Punjab Spearmint-1
Sarpagandha	*Rauwolfiaserpentina*	R.S.1
Khasikateli	*Solanumviarum*	ArkaSanjeevani, ArkaMahima
Steroidal yams	*Dioscoreafloribunda*	PB(c) I, ArkaUpkar
Foxglove	*Digitalis lanata*	D 76
Long Pepper	*Piper longum*	Viswam
Mushakbala	*Valerianajatamansi*	Dalhousi Clone
Java citronella	*Cymbopogonnardusvar. mahapengiri*	'Jorlab C2', 'RRL JOR-3-1970', 'CIMAP/Bio-13',CIMAP/73-1', Manjari, JalPallavi, Medini, Manjusha, Mandakani
Patchouli	*Pogostemon patchouli*	'Johore', 'Singapore', 'Indonesia
Tuberose	*Polyanthestuberosa*	Calcutta single', 'Mexican Single', 'RejatRekha', 'SuvarnaRekha
Aloe	*Aloe barbadensis*	IC-111271, IC 111280, IC 111269 and IC 111273
Guggal	*Commiphorawightii*	Marusudha, GAU-1
SafedMusli	*Chlorophytumborivilianum*	JawaharSafedMusli 405, NRCCB-1, NRCCB-2
Coleus	*Coleus forskholii*	Maimul, Garmai
Rosemary	*Rosamarinusofficinalis*	CalaGonone’,SetteFratelli’, Gerrei’ Sant.Antioco’, Vignola, ‘Costa Paradiso’
Stevia	*Stevia rebaudiana*	RSIT 94-1306, RSIT 94-75, RSIT 95-166-1, Madhuguna, Yungri, SM 4, ACBlack Bird’’

CONCLUSIONS

MAPs are characterised by a great number of species diversity with respect to their biological features and the

characteristics that determine their economic value and sustainable use. The properties of the genetic material of these plants have a vital role on production success and, in particular, on the results of postharvest processing. Breeding opens up the avenues to adapt plants to the particular demands of the stakeholders in the production chain. Conventional breeding methods prevail in MAP breeding includes election in natural populations, combination and hybrid breeding, breeding synthetic varieties, induced mutation and clone breeding. The use of markers and to rationalise the methods for trait assessment are available for improving the selection procedures. Contemporary biotechnological breeding methods are highly expensive. Furthermore, consumers prefer natural products due to safety and reject herbal drugs that originate from genetically modified plants because they do not have their natural constitution. Nevertheless, the use of biotechnological tools and research on genes controlling the formation of secondary metabolite and on methods for their transmission are in fancy stage. At present, the exploitation of the genetic potential of MAPs by breeding is yet to be underutilised. Therefore, breeding can become one of the key factors for advancing the phytopharmaceutical sector in the future. Species specific characteristics influencing the success of postharvest processing should be well defined and considered in future improvement programmes.

Such breeding objectives include homogeneity, high content of important constituents and appropriate morphological properties. Breeding research requires to find out how breeding aim scan be implemented in the most effective way. This needs requires thorough investigations on the available natural variability of the concerning characteristics and their genetics, methods of generating new variability, effective selection methods and high performance, low cost and reliable methods for trait refinement.

REFERENCES

1. *Allard, R. W. 1999. Principles of Plant Breeding. Wiley, J/VCH, second ed. 1999.254 p.*
2. *Bhattacharjee, S. K. and De, L. C.2005. 'Medicinal Herbs and Flowers'.Pp-434.* ***.*** *Published by Aavishkar Publishers & Distributors, Jaipur, Rajasthan (ISBN: 81-7910-096-0).*
3. *De, L.C. 2016.Medicinal and aromatic plants of North-East India.International Journal of Development Research, 6(11): 10104-10114.*
4. *Kadner, R. Junghanns W. Hennig, F and Weinrich, B. 2002. Production of plantlets of rosemary (RosmarinusofficinalisL.).Propagation via cuttings (article originalin German).Zeitschriftfür Arznei- & Gewürzpflanzen, 7:319–323.*
5. *Langbehn, J. Pank, F. Novak, J. Blüthner, W.D. Franz, C. Junghanns, W. and Vender, C. 2001.Development of a hybrid variety system in marjoram (OriganummajoranaL.). Euphytica, 118:83–90.*
6. *Lenzi, A. Lombardi, P. Nesi, B. Alambissini, A. Landi, R. and Tesi, R. 2003.Yield and quality of the essential oil ofsome sage (Salvia officinalisL.) varieties. AgricolturaMediterranea, v.133 : 36-42.*
7. *Punia, S.S. and Ramkrishna, K.2002.Induction and exploitationof polygenic variation in coriander (CoriandrumsativumL.) through mutagenesis. National Journalof Plant Improvement, v.4: 62-63.*
8. *Rey, C. 1994.Une variété de thymvulgaire: 'Varico'. Revue Suisse Vitic.RevueSuisse de Viticulture, Arboriculture, Horticulture, 26:249–250.*
9. *Slavova, Y. Zayova, E. and Krastev, S. 2004.Polyploidizatin of lavender (Lavandulavera) in vitro. Bulgarian Journal of Agricultural Science, 10:329–332*